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ABSTRACT

Toddlers with slow expressive language development were compared on three global measures of phonological behavior to age-mates with normal speech development. The measures were the average level of complexity of syllable structures, the number of different consonant phonemes produced, and the percentage of consonants correctly produced in intelligible utterances. The groups were found to differ significantly on all three variables. Further analyses broke the groups down into narrower age ranges and revealed differences between youngsters with normal and late speech development. Detailed analyses of the range of phonemes and syllable structures produced, and of the appearance of phoneme classes within syllable structures and positions, revealed that late talkers showed a delayed rather than a deviant pattern of phonological development. The implications of these findings for identifying and monitoring expressive delay in toddlers are discussed. Contains 32 references. (Author/LB)

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Phonological Behavior in Toddlers with Slow Expressive Language Development

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Phonological Behavior in Toddlers with Slow Expressive Language Development

Abstract

Toddlers with slow expressive language development were compared to normally speaking age-mates on three global measures of phonological behavior: the average level of complexity of their syllable structures, the number of different consonant phonemes produced and the percentage of consonants correctly produced in intelligible utterances. The groups were found to differ significantly on all three variables. Further analyses were done, breaking the groups down into narrower age ranges. These comparisons also revealed differences between late-talking and normal youngsters. Detailed analyses of the range of phonemes and syllable structures produced, as well as the appearance of phoneme classes within syllable structures and positions revealed that late talkers showed a delayed, rather than a deviant pattern of phonological development. The implications of these findings for identifying and monitoring expressive delay in toddlers are discussed.

Phonological Behavior in Toddlers with Slow Expressive Language Development

It is known that older preschoolers with language delays are at a very substantial risk for long-term language, academic and social difficulty (Aram & Nation, 1980; Hall & Tomblin, 1978; Paul &Cohen, 1984). But little is known about the prognosis for toddlers with slow acquisition of expressive language. Normative data for expressive language growth have been well established in the literature, and a variety of sources report average vocabulary size of substantially more than 50 words and the use of some two word combinations at 18-24 months (Bzock & League, 1971; Frankenburg & Dodds, 1967; McCarthy, 1954; Nelson, 1973; Thal & Dale, 1989). Fenson, Dale, Reznick, Hartung & Burgess (1990) reported average expressive vocabulary sizes of 110 words at 18 months and 312 words at 24 months in normal toddlers.

Rescorla (1989) showed that 10-14% of middle class children sampled with the Language Development Survey failed to produce 50 different words or combine words in two word utterances by their second birthday. What is not known is what proportion of these "late talkers" will go on to show chronic deficits in language and related skills, and which will "grow out" of the delay as normal "late bloomers."

The present study examined phonological behavior in toddlers with slow expressive language development (SELD); i.e., those in that lower 15% of the normal distribution who did not produce 50 words or did not combine words by 18-24 months. Stoel-Gammon (1991) has shown that there is a strong correlation between number of

consonants in phonetic inventories and vocabulary size in normal two year olds. Thus there is reason to suspect that toddlers with abnormally small vocabularies would show phonological differences from their normally speaking peers.

Stoel-Gammon (1987) argued that isolated word naming tests are not appropriate tools for evaluating phonological performance in children under three, and suggested that conversational interactions are more valid contexts in which to assess speech sound production. This method has the disadvantage of reducing the intelligibility of the child's sample, since the target of the child's production will not always be known, as it is in samples of elicited imitation used to evoke single word production. This disadvantage, and its resultant loss of inter-rater reliability, has to be weighed against its advantage in ecological validity. In the present study, spontaneous speech samples collected in unstructured mother-child interactions were used.

Robb, Bauer, Sullivan, and Mashima (1990) have argued for the importance of examining both word and nonword vocalizations in studying the speech development of young children. Because nonword vocalizations might contain important information about toddlers' phonological capacity, and because the SELD toddlers produced few interpretable words and were largely unintelligible, both interpretable and uninterpretable wordlike utterances (i.e., those containing transcribable consonants and vowels) were included in the analyses.

Several aspects of phonological behavior were examined in this study. There were three global measures: overall size of phonetic

inventory, averaged complexity of canonical shapes, and percentage of consonants correct in relation to adult target words, when adult targets were interpretable. These aspects of phonological development have been documented to some extent in the normative literature (Paynter & Petty, 1974; Prather, Hedrick & Kern, 1975; Sander, 1972; Stoel-Gammon, 1987; Stoel-Gammon & Dunn, 1985). In addition, Stoel-Gammon (1987) argued that

> norms for children under 3 years should be broad-based, involving measures of several aspects of a client's phonological system. Assessing correct production, or mastery, of a particular phoneme is not...as important as obtaining a general picture of the child's phonological abilities (p. 324).

In order to obtain such a general picture, several more detailed analyses were performed on the data to supplement the three global measures mentioned above. The particular consonantal types used by a majority of subjects in each group were tabulated. The frequency of use of particular syllable types by each subject group was computed. And the basic sound classes (fricative, glides, etc.) were analyzed for their appearance in various syllable structures and positions for each group. Comparisons to data in the literature and to findings for the control groups involved in the present study were made, in order to determine the areas of phonological development in which SELD children differed from their normally speaking peers and to suggest whether the SELD toddlers show a slowed-down version of normal development (phonological delay) or a different pattern of acquisition (phonological deviance). In addition, results that can serve as a beginning step to the establishment of

assessment procedures for several phonological variables studied in this age group are presented, so that more definitive clinical diagnoses of phonological skills in toddlers may eventually be made.

METHOD

In-take Instrument: The Language Development Survey (Rescorla, 1989)

The Language Development Survey (LDS) is a vocabulary checklist consisting of about 300 of the words most commonly found in children's early vocabularies. Parents are asked to check the words their child says and to identify, by citing three examples, whether the child produces any two word combinations. Using a criteria of less than 50 words or no two word combinations at 24 months of age, the LDS has been reported to show good concurrent validity with expressive vocabulary measures on the Bayley Scales of Infant Development (Bayley, 1969), and the Reynell Developmental Language Scale (Reynell, 1984). Sensitivity of the scale is also high, with 89% of children concurrently found to be delayed on the criterion measures. Specificity has been reported at 86%. These data indicate that, using the criteria above, the LDS correctly identifies a high proportion of both normal and delayed toddlers with low rates of false positives and false negatives. Rescorla (1989) also reported high internal consistency and test-retest reliability. In summary, the LDS is reported to be a highly valid, reliable, sensitive and specific instrument for identifying children with slow language growth. Dale, Bates, Reznick, and Morisset (1989) and Reznick and Goldsmith (1989) also discussed the validity of parent checklists as estimates of expressive vocabulary size and find them to be good indices of this variable.

Subjects

Late Talkers

Twenty-eight children were identified as slow in expressive language development (SELD). These children were divided into two age groups: those who were 18-23 months of age and produced fewer than 10 words (n=9), and those who were 24-34 months of age and produced fewer than fifty words or no two word combinations (n=19), by parent report using Rescorla's Language Development Survey (1989). The subjects were obtained from two sources:

1. All parents of children between 18 and 34 months of age seeking well-baby care during a five month period at three large, private pediatric practices were asked to complete the LDS.

2. Advertisements were placed in local newspapers and on talk radio programs for families with toddlers who were were "late talkers." Interested families were asked to contact the first author by telephone. Those responding were sent an LDS and asked to complete it.

All subjects who met the above criteria for vocabulary size were invited to participate in a longitudinal study of language development. Their mean age at the time of intake was 25.3 months (s.d. 4.9). The mean socioeconomic level for the group, using Myers and Bean's (1968) four factor modification of the Hollingshead method, was 2.89 (s.d. 0.9) on a scale from one to five with one being the highest SES level. The group was 64% male.

Normal Group

Twenty-five normal subjects were drawn from the group recruited at the pediatric practices. Subjects whose parents indicated on the LDS that their toddlers used more than 10 words at 18-24 months or

more than 50 words and some two word combinations at 24-34 months were considered candidates for the normal group. Normal subjects were selected so that the normal and SELD groups were matched for age, sex ratio, and socioeconomic status (Myers & Bean, 1968). Mean age of this group was 24.9 months (s.d. 4.0). Mean SES was 2.49 (s.d. 1.32) The group was 71% male. There were 8 children in the 18-23 month age group and 17 in the 24-34 month group.

Procedures

Screening

All subjects obtained a score greater than 85 on the Bayley Scales of Infant Mental Development (Bayley, 1969), administered by a trained psychologist. Since 19 of the 40 Bayley items in the 18-30 month range assess receptive or expressive language skills, SELD subjects would be expected to score lower than normal counterparts. Thus comparing the groups on the basis of total Bayley scores would only reflect the depressed language skills of the SELDs. Instead, the average number of nonverbal items passed on the Bayley was computed for each group and the two groups were compared on this measure. These findings are reported in detail elsewhere (Paul & Elwood, 1991) and reveal that the two groups were quite comparable in terms of nonverbal scores on the Bayley.

Subjects were screened for autism by observations of their play interactions with parents and by ratings of their social orientation. All subjects passed this observational screening. In addition, standard oral peripheral structure and function assessments were administered to each subject to screen out those with obvious neuromotor deficits. One child was eliminated from the

study on the basis of this screening. Hearing screenings were conducted via speech reception threshold in a sound field at 25 dB for all subjects, using visually reinforced audiometry in a sound-proof booth. A Maico model 24B clinical audiometer, calibrated to meet American National Standard Institute specifications (ANSI, 1989) was used. All SELD subjects passed this screening. Twenty two of the normal subjects passed at 25dB, one normal subject passed at 40 dB, and one refused to be tested. Because of their normal language performance, validated on a variety of standardized tests administered at the intake assessment, these children were included in the study.

Receptive language performance, assessed by means of the Reynell Developmental Comprehension Scale (Reynell, 1984), is reported in detail in Paul, Spangle-Looney, and Dahm (in press). These data suggested that the SELD group was functioning, on the average, within the normal range of comprehension ability, and that all the normal subjects scored within the average range or above on this measure.

Phonological Evaluation

Videotaping

Subjects were videotaped during an exactly timed ten minute unstructured play session with their mothers in a university clinic room. Two trained graduate students used a Panasonic Vicon WV-3150 video camera and an Electrovoice dynamic microphone linked to a Panasonic NV 8200 video cassette recorder. Each mother-child pair was provided with a standard set of toys including dolls, a telephone, dishes, blocks, stacking toys, cars, and a "Poppin' Pals" toy.

Each parent was told to "play with your child and these toys as you would at home."

Transcription

The second author transcribed the vocalizations produced by each child. During the transcription process, the coder was blind to the subject's diagnostic group assignment. Speech samples were transcribed according the the procedures described in the Language Production Scale (Olswang, Stoel-Gammon, Coggins, & Carpenter, 1987; Stoel-Gammon, 1989). Speech samples of 50 consecutive different words or word-like utterances from each subject were transcribed using broad phonetic transcription. Exact repetitions of each word or word-like utterance were tallied, but only the original utterance was counted in the analysis. For those subjects who did not produce 50 utterances during the ten minute sample, as many utterances as were present were used. The smallest number of utterances produced was three. The mean number of utterances produced by the normal group was 41.38 (range: 10-50); the mean for the SELDs was 23.58 (range: 3-50).

The following rules (adapted from Olswang et al., 1987; Stoel-Gammon, 1989) were followed in the transcription process:

1. The sample consisted of up to fifty consecutive different vocalizations, consisting of a minimum of a voiced vocalic element or a voiced syllabic consonant, produced with an egressive airstream.

2. Any vocalization that could not be transcribed confidently after four hearings was eliminated.

3. Any utterance that occurred simultaneously with any other sound on the tape, such as parental speech or the noise of a toy, was not transcribed.

4. Cries, coughs, or screams were not transcribed.

5. Babbled, or uninterpretable utterances, were required to be bounded by one second of silence on either side, or by the noises noted above, or by a breath or by adult speech.

6. Words and word-like utterances were identified by the phoneme content (words) or by their inflection (word-like utterances).

Coding.

Syllable structure level. Each utterance was assigned to one of the following Syllable Structure Levels (SSLs), adapted from Olswang et al. (1987):

Level 1: the utterance is composed of a voiced vowel([a]), voiced syllabic consonant([iii]), or CV syllable in which the consonant is a glottal stop ([ʔO]) or a glide ([ha],[wi])

Level 2: the utterance is composed of a VC ([up]) or CVC with a single consonant type ([kek]), or a CV syllable which does not fit the criteria for Level 1. Voicing differences are disregarded.

Level 3: the utterance is composed of syllables with 2 or more different consonant types, disregarding voicing differences ([pati]).

Mean SSL was computed for each subject by adding the scores (1,2, or 3) assigned to each utterance and dividing by the number of utterances coded. Mean SSL for each group was computed by averaging the mean SSLs for each subject within each group. In addition, the frequency of appearance of each syllable type (CV, VC,

VC, etc.) at each level was tabulated for each subject, and summed for all subjects within each group.

Percent consonants correct(PCC). The number of interpretable words transcribed for each subject was computed. For those subjects who produced at least ten different intelligible words, the percentage of consonants correctly produced relative to the adult target word was calculated, following Shriberg & Kwiatkowski (1982). The average percentage of consonants correctly produced was derived for each group.

Number and distribution of consonant types. The consonant inventory for each speech sample was tallied, following Shriberg and Kwiatkowski (1981). The number of different consonants produced by each subject in both interpretable and uninterpretable utterances was counted, and the average number of different consonant types produced by the subjects in each group was computed. In addition, the particular consonant types used by each subject were tabulated. Finally, consonants for each subject were grouped into classes, roughly corresponding to developmental order of acquisition: glides ([h, w, j]), front stops and nasals ([p, b, t, d, m, n]), back stops and nasals ([k, g, n]), fricatives ([f, v, s, z, ʃ, ʒ, θ, ð]), affricates ([tʃ, dʒ]), and liquids ([l, r]). The appearance of each of these phoneme classes in basic syllable types and positions (initial singletons in monosyllables, final singletons in monosyllables, blends - all positions in monosyllables, and multisyllabic words - all positions) was summed for the subjects within each group.

Reliability

Inter-rater reliability was assessed by having a second trained transcriber independently retranscribe and recode, according to the procedures described above, a randomly selected ten percent sample of the videotapes. A point-to-point reliability method was used (McReynolds & Kearns, 1983), and indicated 87.5% reliability for the computation of syllable structure level, 87.7% agreement on the percentage of consonants correct, and 85.0% reliability for the consonant inventories.

RESULTS

The three global measures gathered from the two diagnostic groups --mean SSL, percentage of consonants produced correctly in interpretable words, and number of different consonant types produced -- were compared, using the Student's t-test. In addition, the groups were broken down by age, and comparisons of younger and older subjects were made. Finally, frequency totals for phoneme types, syllable structures, and sound classes within syllable structures were computed for each subject group.

Prior to analysis of the data described above, tests were conducted in order to determine whether the groups were matched for age and number of utterances produced. These results are shown in Table 1. Students' t-tests indicated that the normal and SELD groups were not significantly different in terms of age, but there was a significantly higher average number of utterances produced by the normal subjects.

INSERT TABLE 1 ABOUT HERE

Diagnostic Group Comparisons

...llable structure level. The mean SSL for the normal group (n=25) was 2.3 (s.d. 0.2). The mean for the SELD group (n=28) was 1.7 (s.d. 0.4). The normal group's mean SSL was significantly higher (t [50]= 7.15, p< .05).

Percent consonants correct (PCC). Only scores of those subjects who produced at least ten intelligible words were used in this analysis. The percentage of consonants correctly produced in the normal group (n=22) was 66.5 (s.d. 18.8). The percentage produced by the SELD group (n=13) was 56.2 (s.d. 11.7). This difference was significant (t [33]= 1.78, p<.05).

Number of different consonant types. The mean number of different consonants produced in interpretable and uninterpretable utterances by the normal group (n=25) was 16.5 (s.d. 3.5). The number of different consonant types produced by the SELDs (n=28) was 8.7 (s.d. 4.9). This difference was significant (t [50]=2.58, p<.005).

Comparisons Using Subgroups Based on Age

The two diagnostic groups were each subdivided into subgroups based on age. The 18-23 month olds in each diagnostic group were considered the "younger" subgroup, while the 24-34 month olds in each diagnostic group comprised the "older" subgroup. Means for these comparisons are shown in Table 2.

Comparison across diagnostic groups. There were no significant differences in terms of age between the younger subjects in the normal and SELD groups. Mean age for the younger normals (n=8) was 20.1 months (s.d. 2.0), and that for the younger SELDs (n=9) was 20.3 months (s.d. 1.6). Similarly, there were no significant age differences between the older normal (n=17) and SELD (n=19) groups. Mean age for the older normals was 27.9 months (s.d. 3.7) and for the older SELDs, 27.1 months (s.d. 2.7).

INSERT TABLE 2 ABOUT HERE

Student's t-tests were performed in order to compare the scores of the older subjects in the SELD group on each of the three global variables (SSL, percent consonants correct, and number of different consonants) with those of the older normals. Younger normal and SELD groups were also compared on the same three variables. These results are displayed in Table 3. The older normal subgroup's scores were significantly higher than those of the older SELDs in all three comparisons. The younger normal subjects' scores were significantly higher than those of the younger SELDs in terms of mean SSL and number of different consonants produced, but not in terms of percent consonants correct.

INSERT TABLE 3 ABOUT HERE

Comparison of younger vs. older subjects. To examine differences that occurred with development in this population, the scores for the younger vs. older subgroup within each diagnostic group were contrasted.

As can be seen in Table 3, significant differences were seen in the normal group between younger and older subjects in terms of percent consonants correct and number of different consonants produced. There was no significant developmental change in mean Syllable Structure Level. The results in the SELD group were parallel: significant differences appeared between younger and older groups in percent consonants correct and number of different consonants produced, but not in terms of mean SSL.

Phonological Properties of Toddlers' Speech.

In order to paint a general picture of the phonological skills of normal and SELD toddlers, raw frequencies of phoneme types, syllable structures, and phoneme classes appearing within syllable types and positions were computed for each of the four subgroups. Raw frequencies were used because at both age levels (younger [18-23 months] and older [24-34 months]) there were a few more subjects in the SELD group. Because of this fact, a lesser frequency of appearance of phonemes or syllable structures could not be associated with a smaller sample size for the SELDs. If the SELDs used fewer examples of the target forms, even though there were more subjects producing the data, it would be clear that the discrepancy was a result of a real decrement, relative to normal peers, in phonological production. These data were not subjected to statistical

analysis, but rather were used to give a descriptive picture of the pattern of phonological behavior of each of the subgroups, and to suggest whether the patterns seen in the SELDs could best be described as a slowed-down version of normal or a deviant pattern of acquisition. Because there were about twice as many subjects in each of the older subgroups relative to the younger subgroup for each diagnostic group, frequencies across age groups were not directly comparable.

INSERT TABLE 4 ABOUT HERE

Consonantal Types.

Table 4 displays the consonants found in the phonetic inventories of 50% or more of the subjects in each of the four subgroups, following Stoel-Gammon (1985). As can be seen there, the majority of younger normal subjects produced essentially the full range of consonant types except for the palatal and interdental fricatives and the affricates, with [t] [d] and [w] appearing in inventories of more than 90% of the subjects. Older normal toddlers showed a similar distribution of consonant types, with [ʃ] and an interdental fricative being added to a majority of inventories. The main difference between the younger and older normal subjects was the greater number of consonantal types used by over 90% of the subjects, with all stops, front nasals, and several fricatives achieving this essentially universal use.

Inventories from the SELD groups contrasted markedly with their normal age mates. In the younger SELD group **no** consonantal phone appeared in 50% of the inventories. Those listed in Table 4 comprise the phones that appeared in **any** inventory, and the

prevalence of these phones never exceeded 10%. The phones that appeared in any of the inventories included stops, nasals, and glides, as well as alveolar fricatives and [r]. Although some consonants did appear in a majority of inventories in the older SELD group, the number was smaller than that found even for the younger normals. The phonemes that appeared in a majority of inventories included only stops, front nasals, and glides, the phonemes that generally appear earliest in normal acquisition (Stoel-Gammon and Dunn, 1985). Only [m] was used by over 90% of this group.

Comparing phonetic inventories of younger normals with older SELDs showed strong resemblances, however. The main difference between the two lists is that the younger normal children used more fricatives: [s], [z] and [f] were used by a majority of normal 18-23 month olds, but not by a majority of SELD two year olds. Thus it appears that the SELD children are acquiring earliest the consonants that generally appear first in normal development. In terms of phonetic inventories, their pattern appears to be a slowed down version of normal development.

INSERT TABLE 5 ABOUT HERE

Syllable Structure

Table 5 shows the frequency of appearance of syllable structures at each Syllable Structure Level for each subgroup. As can be seen there, all the groups were fairly similar in their use of Level I structures, those containing only glides and glottal stops.

For Level II structures (those containing only one consonant type per syllable) again, the patterns were quite similar. The most prevalent syllable type at this level for all groups by far was the CV.

Older subjects also produced substantial numbers of CVC and CVCV syllables. The only striking difference at this level appears in the production of VC syllables by the older groups. Normal two year olds produced substantially more VC syllables than their SELD age mates, suggesting, perhaps, a relative difficulty with the production of syllable final consonants in the SELDs. There were few examples of Level II VCs for either of the younger groups.

At Level III, consisting of those syllables containing two or more different consonant types, both normal groups produced considerably more of the CVC(V) syllables, the most basic syllable type at this level, than their SELD age-mates. Both normal groups also produced a much larger number of two syllable words than their SELD peers. In addition, the older normal children produced substantially more syllables containing consonant clusters in either the initial or final position than did SELD two year olds. Few syllables containing blends were produced by 18-23 month olds in either diagnostic group.

In terms of syllable structures, then, the SELD children generally produced the same types of structures as their normal age mates, but produced fewer of the more advanced syllable types such as VCs, syllables with clusters, and disyllabic productions. Again, the SELD children's phonology appears to be delayed relative to their peers, but not to be qualitatively different.

INSERT TABLE 6 ABOUT HERE

Consonant Types Within Syllables.

In Table 6 the consonants from the subjects' consonant inventories were divided into six broad classes, which appear in the table in roughly their developmental order of acquisition (Stoel-Gammon & Dunn, 1985). These classes are: glides ([h, w, j]), front stops and nasals ([b, p, d, t, m, n]), back stops and nasals ([k, g, n]), fricatives ([s, z, f, v, ʃ, ʒ, θ, ð]), affricates ([ʧ, ʤ]), and liquids ([l, r]). The number of instances of consonants from each broad class in initial singletons for all monosyllables uttered was summed across the Syllable Structure Levels for each subject. The same was done in the case of final single consonants in monosyllables. These data were then summed for all subjects within each of the four subgroups. These frequencies of appearance are given in Columns IS and FS in Table 6. In addition, two syllable types that could occur only at Level III were treated in the same way. The number of instances of phonemes in each of the six broad classes that appeared in consonant clusters in any position in monosyllables was computed for each subject and summed across subjects within each subgroup. The number of instances of phones in each of the six classes was also computed for all positions in multisyllabic (two and three syllable) words. Thus, Table 6 gives a picture of the distribution of sound classes within the basic syllable structures that occurred in the speech samples analyzed.

As Table 6 shows, the patterns of appearance of consonantal classes for the four groups were quite similar. The most prevalent class in all subgroups was the front stops and nasals, with back stops

and nasals, fricatives, and glides being the next most prevalent categories for all subgroups. However, fricatives appeared very infrequently in any position in the samples of the younger SELDs. Liquids were used less frequently than glides, fricatives, or back stops and nasals by all groups. Affricates were infrequent in all the samples.

All classes were used most frequently by all subgroups in initial singletons, except for the greater use of fricatives in final than initial singletons by the 18-23 month old normals. The finding of more frequent fricative use in final than initial position accords well with other normative data for this age group (Shriberg & Kwiatkowski, 1980), but was not replicated in the SELD groups. Generally, all classes were used more frequently in final singletons than in blends or multisyllabic words by all subgroups.

Front stops and nasals were the class that appeared most frequently in initial singletons for all subgroups. The same was true for multisyllabic words. Use of front stops and nasals in these syllable shapes always exceeded the use of back stops and nasals, fricatives, or liquids by a factor of two or more. It is interesting to note that all subgroups produced more multisyllabic words than words containing consonant clusters, and this was true within each phoneme class, with the one exception of liquids in the older normals. In clusters, too, front stops and nasals were the most prevalent sound class for all groups. Older normal subjects used a substantial number of fricatives and liquids in clusters, as well as some back stops and nasals. For younger normals, fricatives, back stops and nasals, and liquids appeared in clusters, but the frequency

in any class was quite small. The same was true for the older SELDs. Younger SELDs used only front and back stops and nasals in blends, and, again, the frequency of use of both these classes in clusters by young SELDs was very low.

In summary, use of consonantal classes within syllable shapes shows no evidence of deviant development in SELD toddlers. Although their usage of sound classes and syllable structures was always less frequent than those of their normally speaking peers, SELD youngsters show patterns similar to those of normals with early-developing sound classes and canonical shapes predominating.

DISCUSSION

These data support the notion that children who are slow to acquire expressive vocabulary are phonologically less advanced than their normally speaking peers. On all three global measures of phonological performance, the SELD group was rated significantly lower than their normally speaking counterparts. When the groups were broken down further by age, the 24-34 month old SELDs were, again, poorer on all three global measures of phonological maturity than the normal two-year olds, and showed a less mature picture of use when detailed analysis of consonantal classes and canonical structures was applied. The 18-23 month old SELDs were significantly worse than their normal age mates on two of the three global measures, Syllable Structure Level and number of consonants produced, and were also much more limited in terms of the sound classes and syllable structures used.

These findings strengthen the suggestion made by Stoel-Gammon (1991) that speech and language development are intimately connected during the early stages of language acquisition. The direction of causation for this relation is not currently known. That is, it may be that late talkers have poor phonological skills, reflecting slow oral motor or phonological processing abilities, and that this lag is a primary cause of their slow expressive language development. On the other hand it is possible that phonological skills in this group are depressed because the late talkers talk less. That is, they get less practice with phonological production because of their dearth of speech, and this lack of practice itself retards phonological development. Whatever the direction of causation, children with slow speech development appear to show deficits in both lexical/syntactic and phonological aspects of their development. Programs designed to address delays in this population should consider targeting both these aspects for change.

In looking at the developmental aspects of the present data it appears, first of all, that ~~normally~~ developing children between 18 and 24 months of ~~age~~ are similar to their two year old counterparts in the complexity of their syllable structures primarily because both age groups are already producing syllables with more than one consonant. The mean SSLs for both groups are above 2, suggesting that a good proportion of the syllables produced contained at least two different consonants. Detailed analysis of syllable structure production revealed normal 18-23 month olds were, indeed, producing a substantial number of both Level II and Level III syllables, with Level II CVs, Level III CVC(V)s and two syllable

words predominating. Because the number of older normals subjects was twice the number of younger ones, comparisons of frequencies of usage across the two age groups are difficult. Longitudinal research is needed to flesh out the picture of changes in syllable structure production in the second and third year of life. But the present data suggest that by age 18 months, normal children can be expected to produce some syllables containing two different consonants and to produce a substantial number of two syllable words. Further, the data suggest that SELD children do not change significantly in terms of average Syllable Structure Level over the age span studied. Although the fine-grained analyses of syllable structure usage did suggest that the SELD youngsters produced a range of syllable types at both age levels, the frequency of use of the higher level shapes remained low for both younger and older SELDs. Thus it would be relatively easy clinically to assess this aspect of phonological development and use it as one index of phonological maturity in a child as young as 18 months. The use of Syllable Structure Level as an assessment of phonological maturity may be a relatively efficient and effective index for monitoring the phonological progress of late talkers. Eighteen to 24 month olds who show increases in average SSL over a three or six month period might be considered less at risk than those who do not show much change in this measure, even if speech continues to be unintelligible.

The data show that normal children produced an average of about 14 different consonants (regardless of position) between 18 and 24 months and about 18 between 24 and 34 months. This developmental change was significant. SELDs, on the other hand,

produced an average of six different consonants at 18-24 months and ten at 24-34 months. The analysis of distribution of consonants in inventories showed that the phones likely to appear in SELD inventories are those that typically occur earliest in the speech of normal children. While the groups in this study are too small to provide norms, the findings do suggest that number of different consonants produced is a sensitive indicator of both development and delay. Further normative studies of phonological production in toddlers may eventually allow clinicians to use this measure in order to evaluate phonological status in young children.

Percent consonants correct changed dramatically in the normal children in this study, from slightly less than 50% in 18-23 month olds to nearly 75% in 24-34 month olds. SELDs also changed significantly in this regard, from about 35% correct to about 56%. It should be noted that the SELD two year olds were about as correct as the normal 18-23 month olds. The number of subjects who could be included in this analysis was limited by the condition that each had to produce at least ten intelligible words, and was therefore, relatively small. Also, there were more normal than SELD subjects who qualified for this analysis (22 vs. 13, respectively), so that results may be somewhat unrepresentative for the SELD group. In general, though, it can be said that even when their speech was intelligible, SELD toddlers produced fewer consonants correctly than their normally speaking peers, but that their performance did tend to improve with age.

The picture drawn by this study of the phonological skills of toddlers with slow expressive language development is one in which

the SELD toddlers are less accurate in their production of consonants, less varied in their consonant repertoires and more restricted in the complexity of syllable structures that they can produce, when compared to normally speaking peers. SELD toddlers appear to improve in both the former aspects of their phonological performance with age, but do not show significant change in the latter, when assessed by a global measure such as SSL, over the time period studied. Their pattern of development shows no evidence of atypicality, and resembles a slowed down version of the normal sequence. These findings suggest that clinical assessment of children who are late to develop speech should include analysis of phonological skills, and that change in these skills should be monitored over child's second and third year. While the global measures used in this study were relatively gross, they did prove sensitive to differences between groups at both age levels. Thus broad categories like these, which are relatively easy to implement clinically, can -- with further normative research -- provide a basis for making diagnostic, prognostic, and intervention decisions about toddlers with slow expressive language development.

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TABLE 1.
COMPARISONS OF MEAN (AND STANDARD DEVIATION) OF AGE, NUMBER OF UTTEREANCES AND NUMBER OF REPETITIONS PER UTTERANCE, BY GROUP

Group	Mean age (mo.)	Number of utterances
Normal	24.9 (4.0)	41.4 (14.6)
SELD	25.3 (4.9)	23.6 (16.4)
Significance of difference between groups	NS	$p<.005$

TABLE 2.
MEANS (AND STANDARD DEVIATIONS) OF SCORES ON PHONOLOGICAL VARIABLES FOR EACH SUBGROUP

Subgroup	AGE (mo.)	Syllable Structure Level	Percent Consonants Correct	Number of Consonant Types
Older Normal (n= 17)	27.9 (3.7)	2.34 (0.17)	73.6 (12.6)	17.9 (2.4)
Younger Normal (n=8)	20.1 (2.0)	2.22 (0.30)	48.6 (22.1)	13.6 (3.7)
Older SELD (n=19)	27.1 (2.7)	1.73 (0.35)	56.3 (28.9)	9.9 (5.1)
Younger SELD (n=9)	20.3 (1.6)	1.55 (0.41)	34.4 (22.8)	6.2 (3.7)

TABLE 3.
RESULTS OF T-TESTS COMPARING SUBGROUPS ON PHONOLOGICAL VARIABLES

Comparison		Syllable Structure Level	Percent Consonants Correct	Number of Consonant Types
Older Normal	t	6.26	2.22	5.76
vs	df	33	24	33
Older SELD	p<	.005	.025	.0005
Younger Normal	t	-3.78	-1.30	4.10
vs.	df	15	9	15
Younger SELD	p<	.005	NS	.005
Older SELD	t	1.20	2.01	1.93
vs.	df	26	11	26
Younger SELD	p<	NS	.05	.05
Older Normal	t	1.23	3.56	3.42
vs.	df	22	21	22
Younger Normal	p<	NS	.005	.005

TABLE 4

Consonants in Phonetic Inventories of More than 50% of Subjects by Group

Group (n)	Phones in Inventory of 50% of Subjects
Younger Normal (n=8)	p, b, t*, d*, k, g, m, n, f, s, z, j, w*, h, r, l
Younger SELD (n=9)	p+, b+, t+, d+, k+, g+, m+, n+, +, s+, z+, j+, w+, h+, r+
Older Normal (n=17)	p*, b*, t*, d*, k*, g*, m*, n*, , f*, s*, z, ?, , j, w, h*, r, l,
Older SELD (n=19)	b, t, d, k, g, m*, n, j, w, h

+ used by any of the younger SELDs. No phones appeared in 50% of the inventories in this group.

* appear in inventories of more than 90% of subjects.

TABLE 5

Frequency of Appearance of Syllable Types

	Younger Normal (n=8)	Younger SELD (n=9)	Older Normal (n=17)	Older SELD (n=19)
Level I				
CV	14	18	42	29
VC	1	2	2	3
CVC	1	13	2	1
CVCV	1	0	0	4
VCV	5	11	3	8
C	2	6	3	16
V	0	15	53	0
OTHER	2	0	0	5
Level II				
CV	47	24	149	124
VC	11	3	86	19
CVC	4	2	18	16
CVCV	11	5	24	30
VCV	3	6	15	16
OTHER	0	1	1	0
Level III				
CVC(V)	50	11	185	61
CVCC	9	2	41	11
CCVC	3	2	19	1
CC(C)VCC	0	0	6	0
2 SYLLABLE	61	11	60	32
3 SYLLABLE	10	2	14	10
OTHER	8	4	18	8

TABLE 6

USE OF SOUND CLASSES BY SYLLABLE TYPE AND POSITION

	GLIDES				FRONT STOPS/ NASALS				BACK STOPS/ NASALS				FRICATIVES				AFFRICATES				LIQUIDS			
	IS	FS	CL	MS	IS	FS	CL	MS	IS	FS	CL	MS	IS	FS	CL	MS	IS	FS	CL	MS	IS	FS	CL	MS
Younger Normals (n=8)	32	-	1	13	73	38	14	35	20	7	3	14	7	20	5	9	0	1	0	5	10	5	2	7
TOTAL				46				160				44				41				6				24
Younger SELDs (n=9)	21	-	1	6	41	6	5	14	5	2	2	4	1	1	0	2	0	0	0	0	0	0	0	1
TOTAL				28				66				13				4				0				1
Older Normals (n=17)	58	-	5	6	249	114	35	57	55	22	10	21	73	52	21	23	6	0	0	3	18	21	15	11
TOTAL				69				455				108				169				9				65
Older SELDs (n=19)	53	-	0	13	191	52	7	39	16	14	2	7	31	12	4	6	3	3	0	3	10	5	5	8
TOTAL				66				289				39				53				9				28

KEY: IS=Initial Singletons (monosyllables) FS=Final Singletons (monosyllables) CL=Blends all positions (monosyllables) MS=Multisyllables (all positions)

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